Amendments to the Specifications: (Clean copy)

BACKGROUND OF THE INVENTION

Please replace paragraph [0001] with the following amended paragraph:

[0001] This invention addresses geometric relationships and designs and the problems that occur with cyclo torque multipliers. Some of those problems are harmonic vibrations (See attached Charts 1 and 2.) and insufficient rigidity which are eliminated with the features described in this patent.

Please replace paragraph [0002] with the following amended paragraph:

[0002] Drawings in Figure 1 (1.1 through 1.11) and Figure 2 (2.1, 2.2, 2.3) show that if the geometric design relations noted in Table 2 are used, a much higher mechanical rigidity, longer gear life, and easier use and application of cyclo gears is accomplished. The most obvious feature is a deeper tooth engagement. The result is a direct force contact. These designs incorporate cyclo-bearing hub-axes with hollow shafts and hollow torque pins. These inventions simplify the building of machines, particularly when multiple cyclo axes are used in sequence, as with base cyclo turn tables and waste and cyclo arm-wrist assembly clusters for robots and other frequently-linked tools. With these cyclo inventions, a more direct and deeper, three-vector multi-line engagement of the cyclo components is guaranteed. Therefore, variable load vectors are controlled and neutralized, and they will not generate harmonic vibrations.

Please replace paragraph [0003] with the following amended paragraph:

[0003] Figure 3 depicts an electrical circuit that is a smoothening, anti-oscillating add-on filter for servo systems. Attached Charts 1 and 2 show oscillation and vibrations that can

be reduced electronically with this smoothening circuit by applying this patented control technology whose results are explained and shown graphically in Figure 4.

Please replace paragraph [0004] with the following amended paragraph:

[0004 The Figure 5 schematic shows the invention of a constantly powered absolute encoder system for controlling a complete servo cyclo axis. It is a single two-channel disk encoder with quadruple (exclusive "or" gate) up/down counter that is both backlash free and directly coupled to motor and cyclo axis, as well as to the program controller - computer.

BRIEF DESCRIPTION OF THE DRAWINGS

Please replace paragraph [0005] with the following amended paragraph:

[0005] Figure 1, Table 1, lists the key parts of the three-disk cyclo gear axis invention. The accompanying drawing, Figure1.1, explains the basic design of the cyclo gear axis in cut view through the center of the assembly.

Please replace paragraph [0006] with the following amended paragraph:

[0006] Figure 1.2 shows the cyclo gear axis with one sun and three planet gears that timely drive the three eccentrics and cyclo disks. Also revealed in the two drawings, Figure 1.1 and 1.2, are three hollow eccentric shafts, one hollow center shaft with sun gear, and three additional passageways in the containing flange. There are also six threaded fastening holes on each side of the axis for tying this axis to other machine units. There are twelve taped holes in the ID-Gear housing for fastening the high torque

flange to other machine parts. In total, the drawings reveal seven hollow channels in the patented cyclo gear axis design.

Please replace paragraph [0007] with the following amended paragraph:

[0007] Figure 1.3 shows part numbers 4, 5, and 6 in cut view. This design allows the hallow channels that are an integral part of these inventions.

Please replace paragraph [0008] with the following amended paragraph:

[0008] Figure 1.4 shows, in cut view, the assembled parts numbers 2, 3, 7, 8, 9 as they are being inserted into part number 1, which is the gear housing shown in Figures 1.5 and 1.6.

Please replace paragraph [0009] with the following amended paragraph:

[0009] Figure 1.7 is identical to Figure 1.1. This Figure is shown side by side with Figure 1.8 to depict the three cyclo disk engagements that ensure equalized force distribution.

Please replace paragraph [0010] with the following amended paragraph:
[0010] For clarity and simplification, Figure 1.6 shows a one cyclo disk engagement.

Please replace paragraph [0011] with the following amended paragraph:

[0011] Table 2 clarifies the cyclo gear relations and symbols. In this cyclo gear system, the gear teeth are round. The center of each tooth lays on the gear's true rollup diameter as shown in Figure 1.9.

- D1 is the roll diameter of the cyclo gear.
- D2 is the roll diameter of the cyclo disk.
- Z1 stands for the amount of cyclo gear teeth (always a whole integer).
- Z2 stands for the number of cyclo disk teeth and is one less than Z1 here.
- R stands for the tooth radius.
- r stands for the arc – radius, generated by tangent of R, R, and D2.
- O stands for the offset of the eccentric and is dimensioned as O= R/2.
- e stands for the angular index of the offset and here is 0, 120, 240 degrees.

Please replace paragraph [0012] with the following amended paragraph:

[0012] Variable load deflections do influence cyclo gear engagements. However, with three disks in constant engagement and zero play and backlash between eccentrics and cyclo teeth, motor and encoder, a vibration induced by the servo and cyclo gears is not possible. The vibrations shown in Charts 1 and 2, therefore, are not possible with these cyclo axes designs. This patented cyclo gear axis velocity Chart is a straight parallel line to the time "t" line.

Please replace paragraph [0013] with the following amended paragraph:

[0013] Table 3 shows samples of cyclo relations starting with only three teeth up to 61 teeth. Gear ratios up to 500/1 are recommended with the Figure 2 type cyclo design and 1500/1 with fore-set planetary gear as in the Figure 1 type cyclo design.

Please replace paragraph [0014] with the following amended paragraph:

[0014] Figure 1.11 shows how this geometrical system fits together and how easily it can

be expanded. It is an economic and ridged high torque system that fits low, medium, and high lot manufacturing technologies such as casting, powder metal pressing, stamping, and CNC manufacturing.

Please replace paragraph [0015] with the following amended paragraph:

[0015] In Figure 2, the basic cyclo torque multipliers are drawn with one, two, and three wave disks. There is only one centered eccentric driving shaft. But there are six hollow drive-out pins with sleeves kept between in the drive-out flanges. The hub-axis, bearing and housing arrangement are improvements here. The cyclo gear and cyclo disks and their relations are identical to the one shown under Figure 1. The expandability of the cyclo axes design is featured here again.

Please replace paragraph [0016] with the following amended paragraph:

[0016] The radial eccentric index (e) is given at 360 degrees divided by the numbers of the disks. For instance, two disks are 180 degrees apart and 3 disks are 120 degrees apart.

Please replace paragraph [0017] with the following amended paragraph:

[0017] The schematic in Figure 3 shows one add-on harmonic damping filter for the analog electronic velocity feedback loop. It is desirable to increase the life of servo components by reducing or eliminating harmonic vibrations. This filter is very easy to apply and is effective in improving life and performance of machine tools and cyclo gears. It filters and reduces vibration.

Please replace paragraph [0018] with the following amended paragraph:

[0018] The results of the frequency shift filter of Figure 3 schematics are shown as trace curves in Figure 4. Considering any velocity vibrations, the high amplitude spikes will be countered by attenuating and delaying the velocity signal to work against the periodic movements. This is called oscillation and velocity vibration damping by electronic means. This is an active countermeasure and is part of these inventions.

Please replace paragraph [0019] with the following amended paragraph:

[0019] Figure 5 shows the schematics of the battery power back-up transistor to transistor logic with two-channel single disk quadrupling encoder up/down counters. It will replace what is currently in use which is an assortment of different geared disk encoders with a multitude of counters. With this new invention which is a constantly "ON", low-powered (infrared) battery-backed encoder system, the rotation position is always known even when the main power is turned off, lost, or interrupted, as long as the battery is powering the encoder. The battery power should supply the encoder and counter for a minimum of five years. A low battery voltage interlock is mandatory.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

Please replace paragraph [0020] with the following amended paragraph:

[0020] The cyclo torque multipliers and controls are used in robotics manipulators, tooling, and production machines and in many industries. They are basically powered and driven by electric or hydraulic servo motors for doing work, such as positioning and flexible programming to do adaptive moves and locating.

Please replace paragraph [0021] with the following amended paragraph:

[0021] Since the invention of the wheel, man has unsuccessfully tried to understand and document all important geometrical relations of the cyclo drive. The inventor of this patent has achieved the simplification of the cyclo gear with all the necessary geometrical relations as shown in Table 2. Important features are the depths of the gear contacts, overall engagement and tooth spacing.

Please replace paragraph [0022] with the following amended paragraph:

[0022] The cyclo module is the radius of the cyclo tooth or roller radius. The gear pitch diameter is the cyclo-module times the number of teeth and it represents the roll-up diameter. The arc roller spacing is also the diametrical pitch. The eccentric offset size "O" is the cyclo module "R" multiplied by 0.5.

Please replace paragraph [0023] with the following amended paragraph:

[0023] Figures 1.1 through 1.8 show how the eccentric shafts, with the bearings and the flanges, together with the cyclo ID-Gear housing, generate high torque. Because of the three cyclo disks and the deep and direct radial contact, the force deflection is neutralized. The shock safety load of this cyclo gear design is very high. There is practically zero load deflection because of the short drive in and drive out shafts which are supported at both ends.

Please replace paragraph [0024] with the following amended paragraph:

[0024] The output torque equals 0.98 x gear-ratios x input torque. This cyclo gear axis efficiency is very high 98%.

Please add the following new paragraphs after [0024]:

[0025] The large hollow eccentric shafts make coaxial lead-through possible. The seven hollows allow passing through of cables, shafts, etc. Because of the two bearing supports of the axis system, the radial and axial loads can be much higher as in cantilevered drive-out cyclo systems.

[0026] The Figure 3 circuit is a dampening anti-oscillating add-on filter for servo systems velocity signal. Inertia, imbalance, cantilevered drive-out, one and two disks cyclo systems without bearing support, and manufactured imperfection influence rotating shafts, gears, and machine elements. These imperfections quite often show up as vibration and oscillation. Servo drives, because of the feedback, and the phase delays stimulate vibration especially if the servo response is working in a high-gain mode. To minimize or eliminate this problem, the add-on-filter for servo systems was invented.

[0027] At Figure 3, the servo correctional signal enters the servo amplifier. Without the servo filter one of the following signals becomes an under-damped signal, as shown in Figure 4. But with the servo frequency and damping filter installed, the Figure 4 signal looks like the critically-damped signal. Connecting the servo Amplifier Output to C1, an added delay will be added and the trace will look like the critical-damped and delayed signal. Without the Figure 3 frequency shift and damping filter, vibrations shown in Chart 1 and 2 are standard. However, the cyclo axes inventions shown here, together with

the servo filter and absolute encoder system will perform smoothly for many productive decades.

[0028] The Figure 5 schematic shows the invention of the new absolute rotating encoder. The rechargeable battery will power the LED and will emit a light beam. The angular rotation encoder has transparent slot windows that let the light path through or stop it. The light will trigger the photo-transistors ON and OFF, making electric square pulses in the channel A and B. If the Channel "A" pulse is leading, the up-counter is counting with increasing counts. If the Channel "B" pulse is leading, then the down-counter is decreasing the counts. The counts represent an axis or gear positions in machine tools, robots, etc. The shift register allows a computer, for instance, to access the counter data for position verification. The battery is charging when the system is powered. The battery is powering the axis counter at all times. This arrangement constitutes an inexpensive absolute counter. This system reduces the absolute encoder cost noticeably and increases the absolute encoder reliability by a minimum of 1000% because of fewer components in use. The cyclo axes positioning is very reliable and completes the system.

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